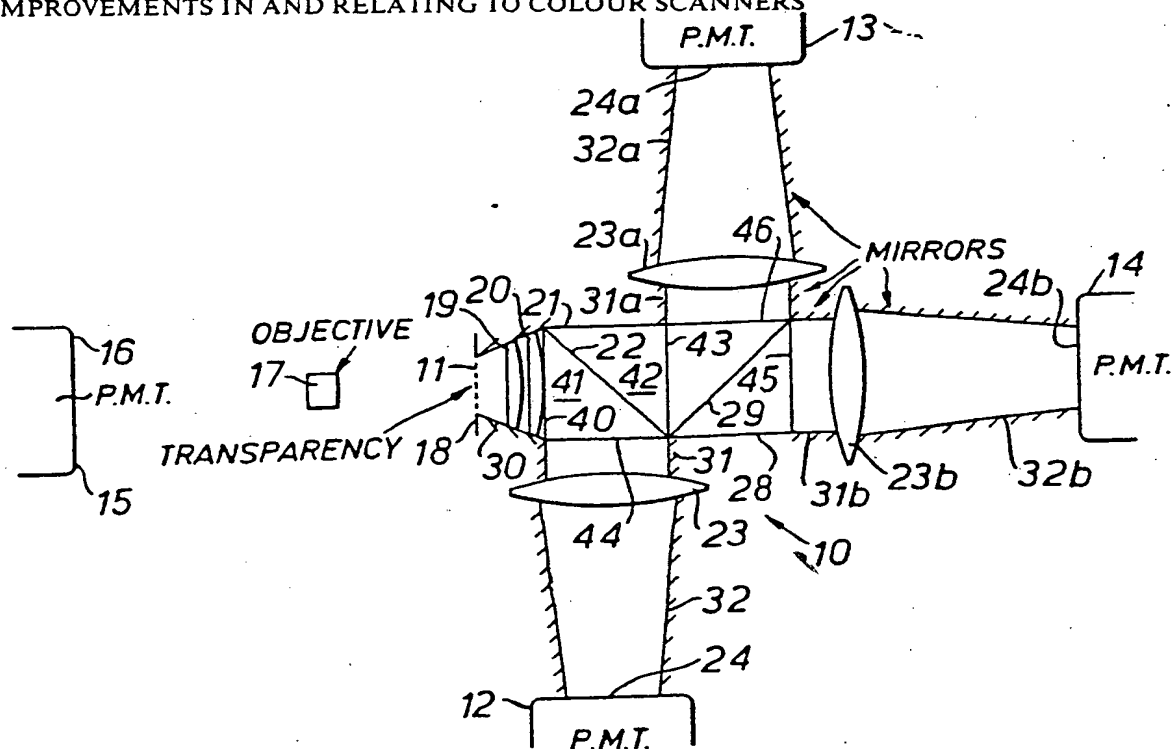




## INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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<b>(21) International Application Number:</b> PCT/GB83/00037 <b>(22) International Filing Date:</b> 9 February 1983 (09.02.83) <b>(31) Priority Application Number:</b> 8204083 <b>(32) Priority Date:</b> 12 February 1982 (12.02.82) <b>(33) Priority Country:</b> GB  <b>(71) Applicant (for GB only):</b> KODAK LIMITED [GB/GB]; Kodak House, Station Road, Hemel Hempstead HP1 1JU, Hertfordshire (GB).  <b>(71) Applicant (for all designated States except GB US):</b> EASTMAN KODAK COMPANY [US/US]; 343 State Street, Rochester, NY (US).  <b>(72) Inventor; and</b> <b>(75) Inventor/Applicant (for US only):</b> WATT, Peter, Ber- nard [GB/GB]; 6 Dewars Close, Welsyn, Hertford- shire (GB).		<b>(74) Agent:</b> PEPPER, J., H.; Patent Department, Kodak Li- mited, 190 High Holborn, London WC1V 7EA (GB).  <b>(81) Designated States:</b> BE (European patent), CH (Euro- pean patent), DE (European patent), FR (European patent), GB (European patent), JP, NL (European patent), US.  <b>Published</b> <i>With international search report.</i> <i>Before the expiration of the time limit for amending the</i> <i>claims and to be republished in the event of the receipt</i> <i>of amendments.</i>

**(54) Title:** IMPROVEMENTS IN AND RELATING TO COLOUR SCANNERS**(57) Abstract**

A colour scanner (10) scans an original (11) with a spot of light and image modulated light is passed to a beam splitter (22, 29) for splitting the modulated light into component wavelength ranges. The component ranges are passed to respective detecting devices (12, 13, 14). To overcome defects in an original such as scratches or dust which cause light scattering, internally reflective containing and directing means (30, 19, 20, 21, 28) define the optical path to the beam splitter so that scattered light from the original is passed thereto.

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IMPROVEMENTS IN AND RELATING TO COLOUR SCANNERS

This invention concerns scanners of the kind where an original information bearing record such as a photographic negative or positive is scanned in a point to point manner by a spot of light and the spot of light is modulated by the information carried by the record. The modulated spot of light is passed to a photomultiplier or like photosensitive device and an electrical signal is generated which corresponds to the instantaneous information carried by the original at that point. Such an apparatus may form part of a telecine apparatus, a photographic printer, a facsimile transmitter or a document copier.

One method of scanning in a point to point manner is to utilise a cathode ray tube and to provide a raster on the face thereof. The raster is imaged on the original information bearing record and the transmitted modulated light, if the original is transparent such as a photographic negative or positive, is detected. It is known, however, to utilise a point light source and appropriate optical components to obtain point to point scanning.

In the case of a transparency, specularly transmitted light causes few problems and a simple optical path, which may include beam splitters, to one or more photomultipliers or like photo-responsive devices, can be used.

One problem that arises in scanners is if the original is dirty or scratched, the light transmitted thereby, if a transparency, is scattered and a proportion is not normally received by the photomultiplier or like photoresponsive device. The output signal of the photomultiplier indicates a high density



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content and density of the transparency, in the form of electrical signals at the outputs of three photo-multipliers 12, 13 and 14.

The scanner comprises a cathode ray tube 15, the electrical circuits of which provide horizontal and vertical time bases to produce a raster on the face 16 thereof of relative dimensions at least corresponding to the dimensions of the transparency 11 to be scanned. An objective 17 images the raster onto the transparency 11 located in a film gate 18. Light transmitted by the transparency is collected by optical path defining means comprising a first truncated pyramidal mirror box 30 surrounding the gate 18, and lenses 19 and 20 direct the collected light onto the planar entrance face 40 of a transparent beam splitting cube 21 forming a further part of the optical path defining means.

The cube 21 comprises two equal right angled prisms 41 and 42 of a relatively high refractive index material such as glass. The hypoteneusal surface of one of the prisms 41 or 42 has a dichroic mirror formed as an interference coating thereon of thickness such as to reflect red light incident thereon at approximately  $45^\circ$  and to transmit green and blue light incident thereon at approximately  $45^\circ$ . The prisms 41 and 42 are cemented together with Canada balsam or a like adhesive with the hypoteneusal surfaces in contact along the line 22.

The cube 21 has a first planar exit face 43 parallel to the entrance face wherethrough green and blue light transmitted by the dichroic mirror exit the cube, and a second planar exit face 44 at right angles to the entrance face 40 wherethrough red light reflected by the dichroic mirror exits the cube. The second exit face is surrounded by a rectangular box mirror 31 having internal reflecting surfaces which

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box mirror contains and directs light exiting the cube at the face 44. A lens 23 followed by a truncated pyramidal mirror box 32 directs such light onto the photocathode 24 of the photomultiplier 12.

5           Abutting the first exit face 43 of the cube 21 is a second similar cube 28 such that the first exit face 43 constitutes also an entrance face for the cube 28. A similarly formed dichroic mirror 29 transmits green light, entering the cube 28 and  
10   impinging on the mirror 29 at approximately 45°, to a first exit face 45 of the second cube 28 and a similar optical arrangement comprising a mirror box 31b, a lens 23b and a truncated pyramidal box 32b collects light exiting the exit face 45 and directs  
15   it to the photocathode 24b of the photomultiplier 14.

          The dichroic mirror 29 reflects blue light, impinging thereon at approximately 45°, to a second exit face 46 whereat a corresponding optical arrangement comprising a rectangular mirror box 31a,  
20   a lens 23a and a truncated pyramidal mirror box 32a collects and directs the reflected light to the photocathode 24a of the photomultiplier 13.

          The lenses 19 and 20 and 23, 23a or 23b serve to image the aperture of the objective 17 as a  
25   circle 25 (or as a polygon if the aperture is formed as an iris diaphragm) (See Fig. 2) on the respective photocathode instead of imaging the transparency 11. The transparency is deliberately totally defocussed on the photocathode. In this way, a constant area,  
30   the circle 25, of fixed location, on the photocathode is illuminated irrespective of the instantaneous location of the spot of light on the transparency 11 and any inequalities of response existing on the detecting surfaces, the photocathodes 24, 24a and 24b,  
35   are eliminated.



CLAIMS

1. A colour scanner comprising a gate whereat a transparency to be scanned may be located, means for scanning the transparency in a point to point manner with a spot of light, a beam splitter located so as to receive light transmitted by the transparency, a photomultiplier or like photoresponsive device located proximate each exit of the beam splitter, and internally reflective optical path defining means between the gate and the exits of the beam splitter.
2. A scanner as claimed in Claim 1 wherein the optical path defining means comprises mirror boxes between the gate and an entrance of the beam splitter.
3. A scanner as claimed in Claim 1 wherein the beam splitter comprises a body of constant rectangular cross-section and of a highly transparent material having a plane entrance face to one end thereof, a dichroic mirror embedded in the body and extending thereacross at 45 degrees to the entrance face, a first plane exit face parallel to the entrance face where-through light transmitted by the dichroic mirror may exit the body and a second plane exit face at right angles to the entrance face and at 45 degrees to the plane of the dichroic mirror wherethrough light reflected by the dichroic mirror may exit the body, the remaining faces of the body forming part of the optical path defining means.
4. A scanner as claimed in Claim 3 wherein the cross section of the beam splitter body in a plane at right angles to the planes of the entrance and exit faces is square.
5. A scanner as claimed in Claim 3 or 4 having a second like beam splitter in abutting relationship by its entrance face to the first exit face of the beam splitter.

6. A scanner as claimed in Claim 3, 4 or 5 wherein the beam splitter body is of a material of high refractive index such as glass.

7. A scanner as claimed in Claim 1 including  
5 further light containing and directing means extending from each exit of the beam splitter to the detecting surface of the respective photomultiplier or like photoresponsive device.

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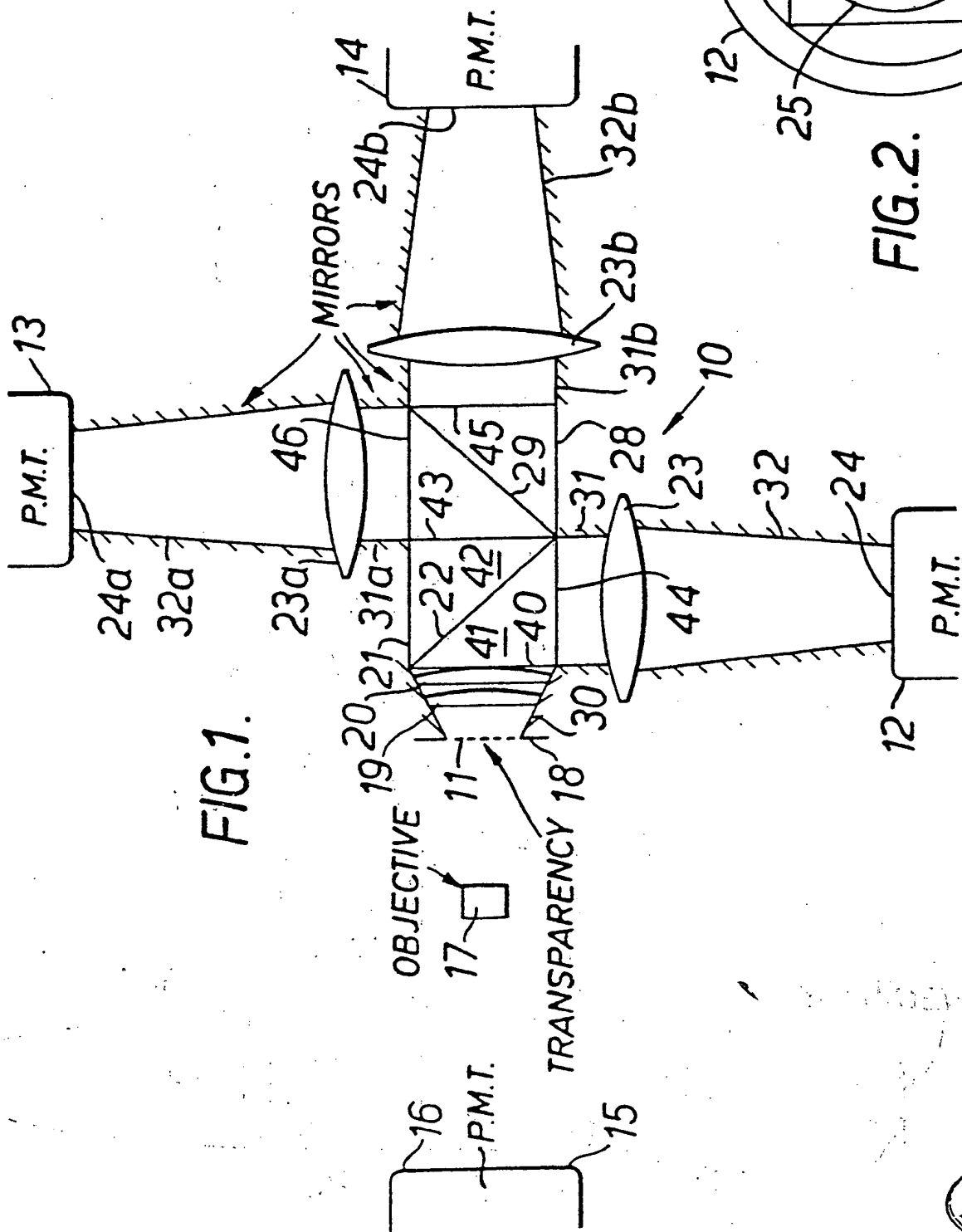


FIG. 1.

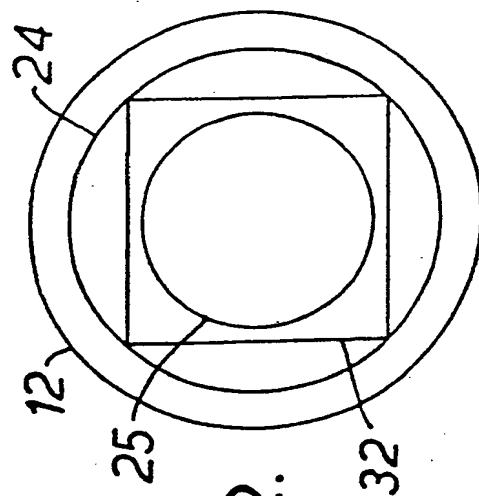
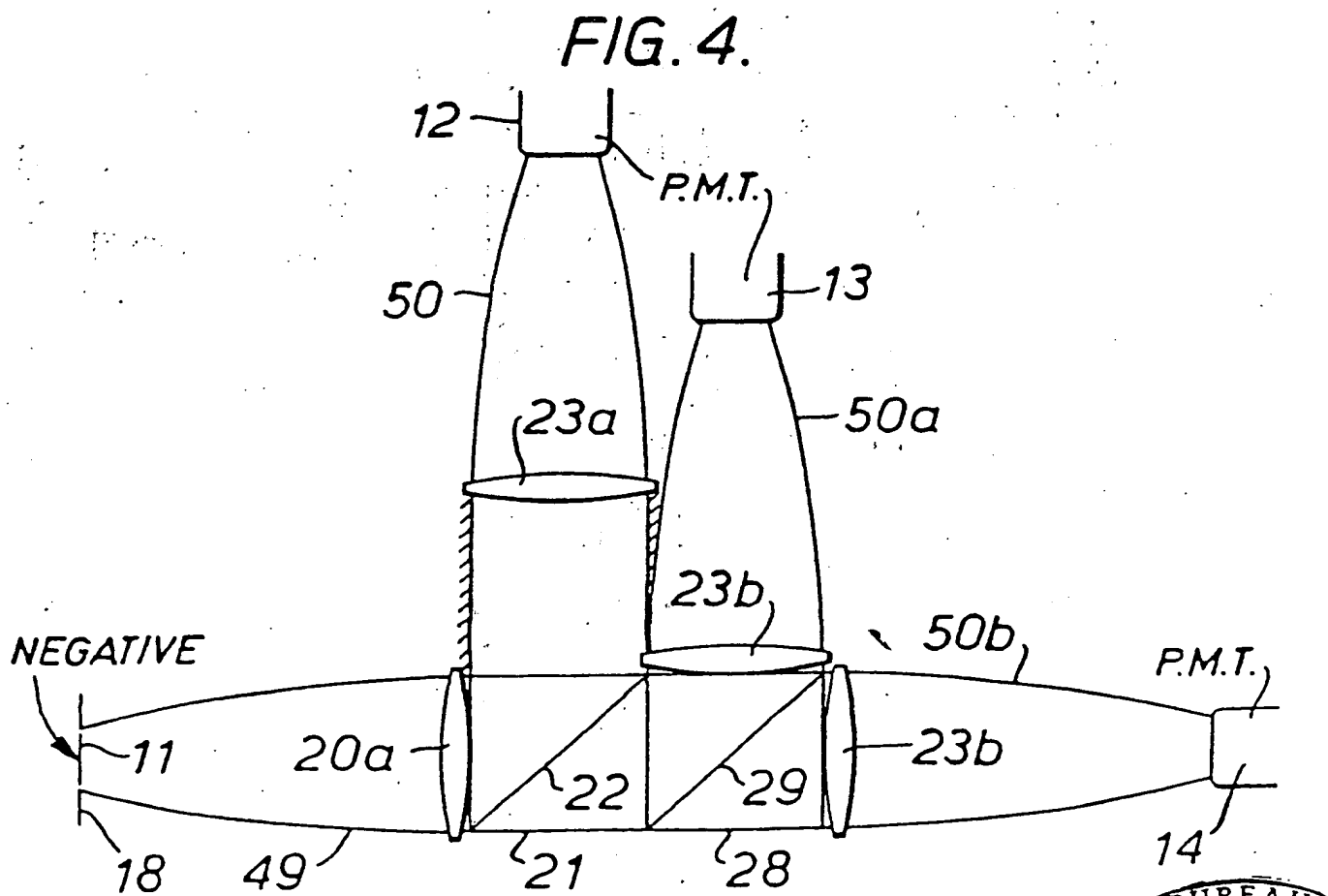
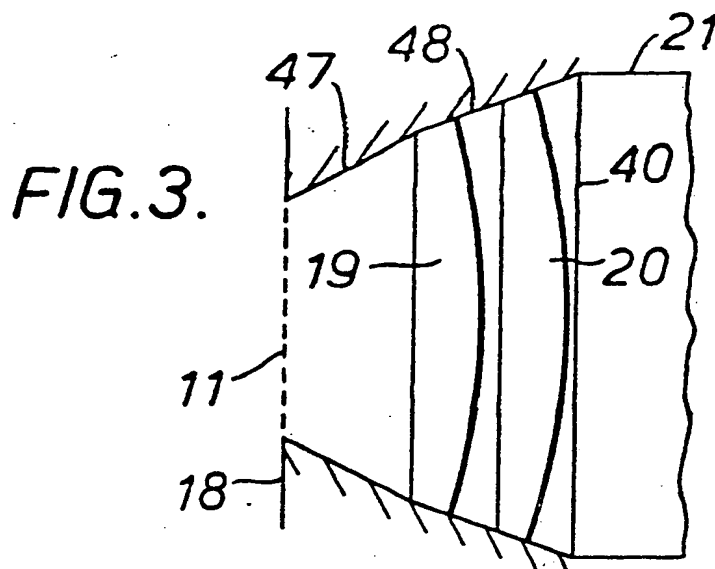


FIG. 2.



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# INTERNATIONAL SEARCH REPORT

International Application No PCT/GB 83/00037

<b>I. CLASSIFICATION OF SUBJECT MATTER</b> (If several classification symbols apply, indicate all) * According to International Patent Classification (IPC) or to both National Classification and IPC <div style="margin-top: 10px;">IPC<sup>3</sup>: H 04 N 9/11</div>																				
<b>II. FIELDS SEARCHED</b> <div style="text-align: center; margin-top: 10px;">Minimum Documentation Searched *</div> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <tr> <td style="width: 25%; padding: 5px;">Classification System</td> <td style="padding: 5px;">Classification Symbols</td> </tr> <tr> <td style="padding: 10px; vertical-align: top;">IPC<sup>3</sup></td> <td style="padding: 10px; vertical-align: top;">H 04 N</td> </tr> </table> <div style="text-align: center; margin-top: 10px;">Documentation Searched other than Minimum Documentation to the Extent that such Documents are Included in the Fields Searched *</div>			Classification System	Classification Symbols	IPC <sup>3</sup>	H 04 N														
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<b>III. DOCUMENTS CONSIDERED TO BE RELEVANT</b> <sup>14</sup> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 5px;"> <thead> <tr> <th style="width: 10%; padding: 5px;">Category *</th> <th style="width: 70%; padding: 5px;">Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup></th> <th style="width: 20%; padding: 5px;">Relevant to Claim No. <sup>18</sup></th> </tr> </thead> <tbody> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3663750 (BESIER) 16 May 1972, see column 3, lines 21-28 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3624286 (BOSOMWORTH) 30 November 1971, see column 4, lines 37-70 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">7</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3617752 (PAGE) 2 November 1971 see column 2, lines 49-55 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">2</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">US, A, 3035179 (PARKER) 15 May 1962 see column 2, line 31 to column 3, line 48 --</td> <td style="text-align: center; vertical-align: top; padding: 5px;">1, 3</td> </tr> <tr> <td style="text-align: center; vertical-align: top; padding: 5px;">A</td> <td style="padding: 5px;">GB, A, 1273360 (MATSUSHITA) 10 May 1972, see page 2, lines 59-69 -----</td> <td style="text-align: center; vertical-align: top; padding: 5px;">4-6</td> </tr> </tbody> </table>			Category *	Citation of Document, <sup>15</sup> with indication, where appropriate, of the relevant passages <sup>17</sup>	Relevant to Claim No. <sup>18</sup>	A	US, A, 3663750 (BESIER) 16 May 1972, see column 3, lines 21-28 --	1	A	US, A, 3624286 (BOSOMWORTH) 30 November 1971, see column 4, lines 37-70 --	7	A	US, A, 3617752 (PAGE) 2 November 1971 see column 2, lines 49-55 --	2	A	US, A, 3035179 (PARKER) 15 May 1962 see column 2, line 31 to column 3, line 48 --	1, 3	A	GB, A, 1273360 (MATSUSHITA) 10 May 1972, see page 2, lines 59-69 -----	4-6
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* Special categories of cited documents: <sup>16</sup> "A" document defining the general state of the art which is not considered to be of particular relevance "E" earlier document but published on or after the international filing date "L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified) "O" document referring to an oral disclosure, use, exhibition or other means "P" document published prior to the international filing date but later than the priority date claimed		"T" later document published after the international filing date or priority date and not in conflict with the application but cited to understand the principle or theory underlying the invention "X" document of particular relevance; the claimed invention cannot be considered novel or cannot be considered to involve an inventive step "Y" document of particular relevance; the claimed invention cannot be considered to involve an inventive step when the document is combined with one or more other such documents, such combination being obvious to a person skilled in the art. "&" document member of the same patent family																		
<b>IV. CERTIFICATION</b> <table style="width: 100%; border: none;"> <tr> <td style="width: 50%; border: none; vertical-align: top;"> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date of the Actual Completion of the International Search <sup>1</sup></div> <div style="text-align: center; margin-bottom: 5px;">30th May 1983</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">International Searching Authority <sup>1</sup></div> <div style="text-align: center;">EUROPEAN PATENT OFFICE</div> </td> <td style="width: 50%; border: none; vertical-align: top;"> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date of Mailing of this International Search Report <sup>2</sup></div> <div style="text-align: center; margin-bottom: 5px;">17 MAY 1983</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Signature of Authorized Officer <sup>10</sup></div> <div style="text-align: right; margin-top: 10px;">G.L.M. Rosenberg</div> </td> </tr> </table>			<div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date of the Actual Completion of the International Search <sup>1</sup></div> <div style="text-align: center; margin-bottom: 5px;">30th May 1983</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">International Searching Authority <sup>1</sup></div> <div style="text-align: center;">EUROPEAN PATENT OFFICE</div>	<div style="border-bottom: 1px solid black; margin-bottom: 5px;">Date of Mailing of this International Search Report <sup>2</sup></div> <div style="text-align: center; margin-bottom: 5px;">17 MAY 1983</div> <div style="border-bottom: 1px solid black; margin-bottom: 5px;">Signature of Authorized Officer <sup>10</sup></div> <div style="text-align: right; margin-top: 10px;">G.L.M. Rosenberg</div>																
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INTERNATIONAL APPLICATION NO.

PCT/GB 83/00037 (SA 4726)

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Patent document cited in search report	Publication date	Patent family member(s)	Publication date
US-A- 3663750	16/05/72	None	
US-A- 3624286	30/11/71	None	
US-A- 3617752	02/11/71	NL-A- 7015903	10/05/71
		FR-A- 2069113	03/09/71
		DE-A, B 2054122	03/06/71
		CH-A- 531818	15/12/72
		GB-A- 1319687	06/06/73
US-A- 3035179		None	
GB-A- 1273360	10/05/72	None	

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